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(54) Local oscillation circuit for band switching

(57) To convert a received signal of different frequency bands (low and high for a VHF television set) to an intermediate frequency, the oscillation frequency of the local oscillation circuit must be changed for each band. The change to a desired frequency is made by shorting a part of a coil in a resonance circuit at high-band reception. However, a feedback capacitor constituting the oscillation circuit is fixed irrespective of the band.

In this invention, the capacity between the collector and the emitter of an oscillation transistor (16) is decreased at high-band reception, while the capacity between the emitter and the base is increased. Conversely, at low-band reception, the capacity between the collector and the emitter is increased, while the capacity between the emitter and the base is decreased. Such switching of a capacity is achieved with one capacitor (21).

Fig.1

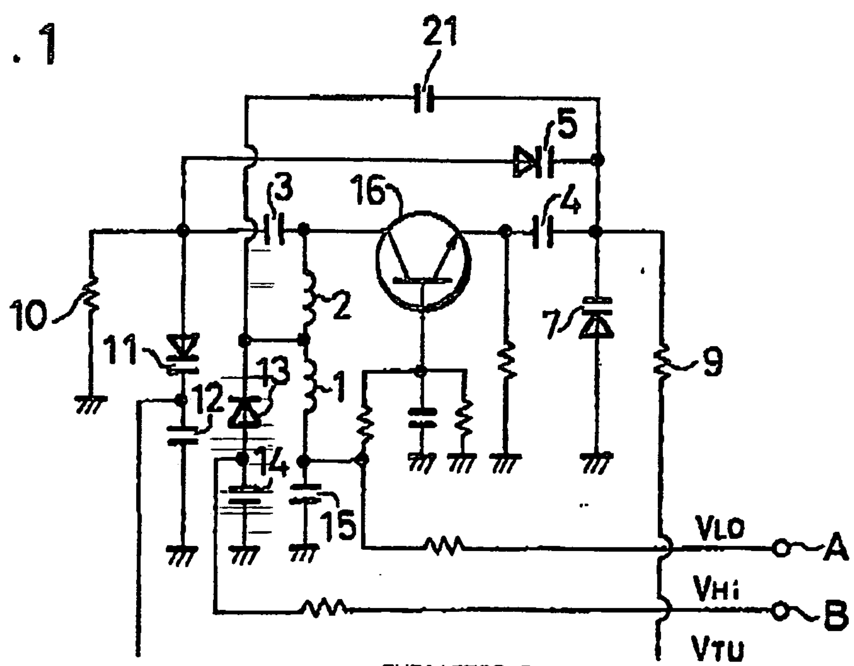

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Fig.1

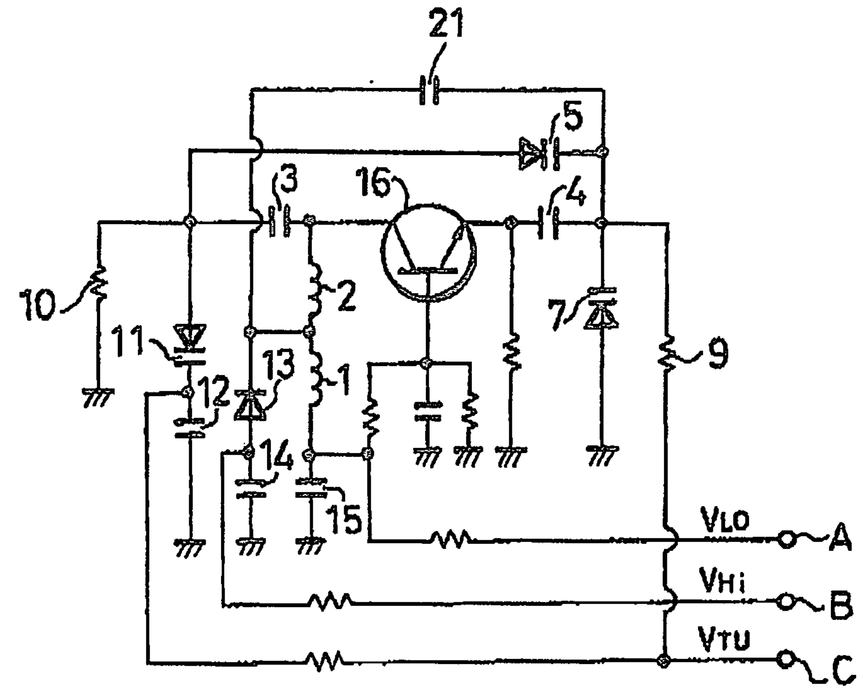


Fig.2

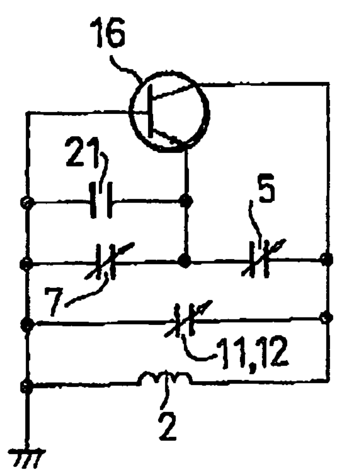


Fig.3

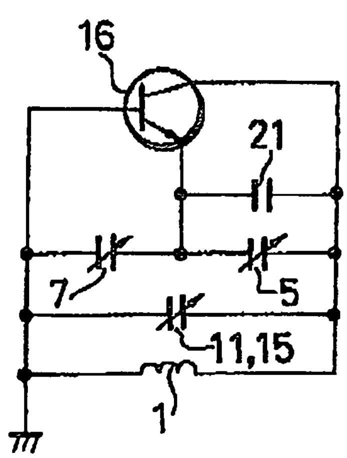


Fig.4

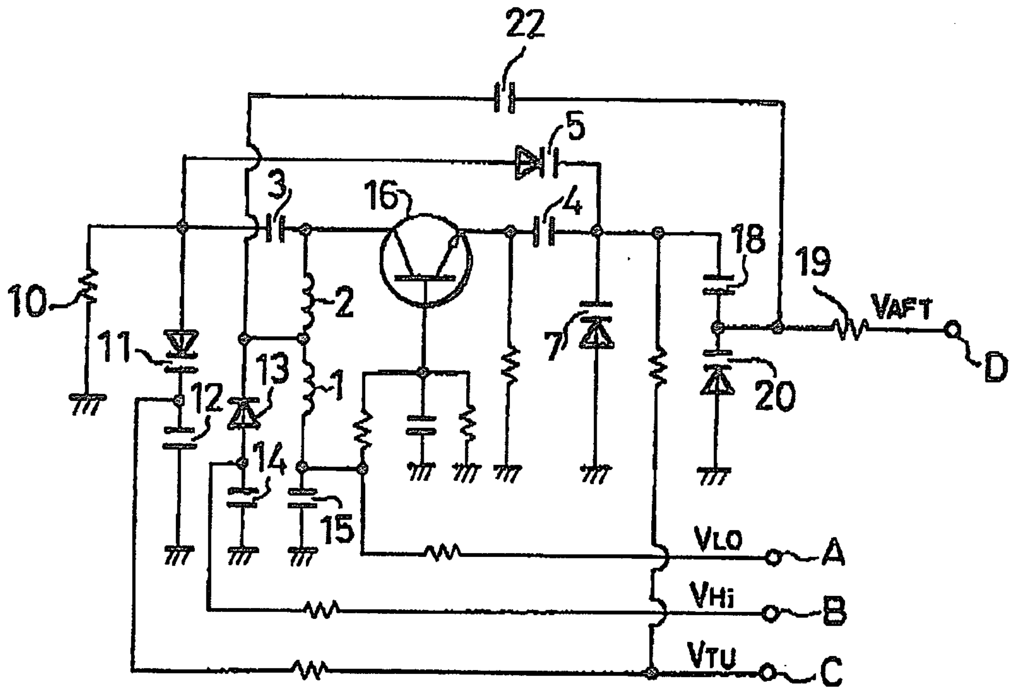


Fig.5

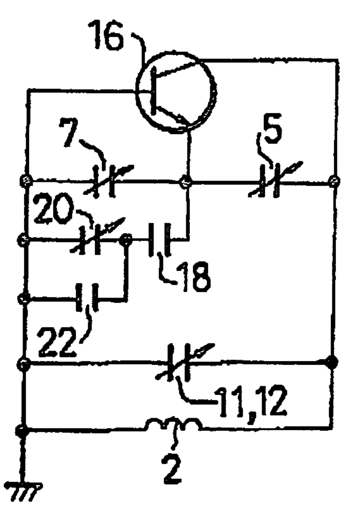


Fig.6

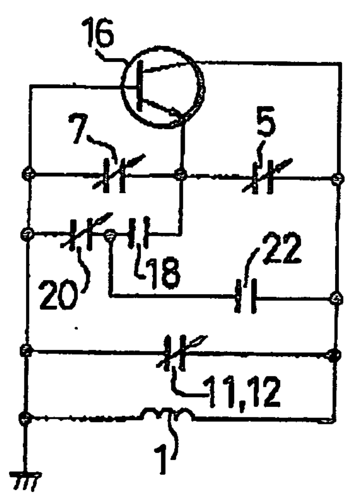


Fig.7

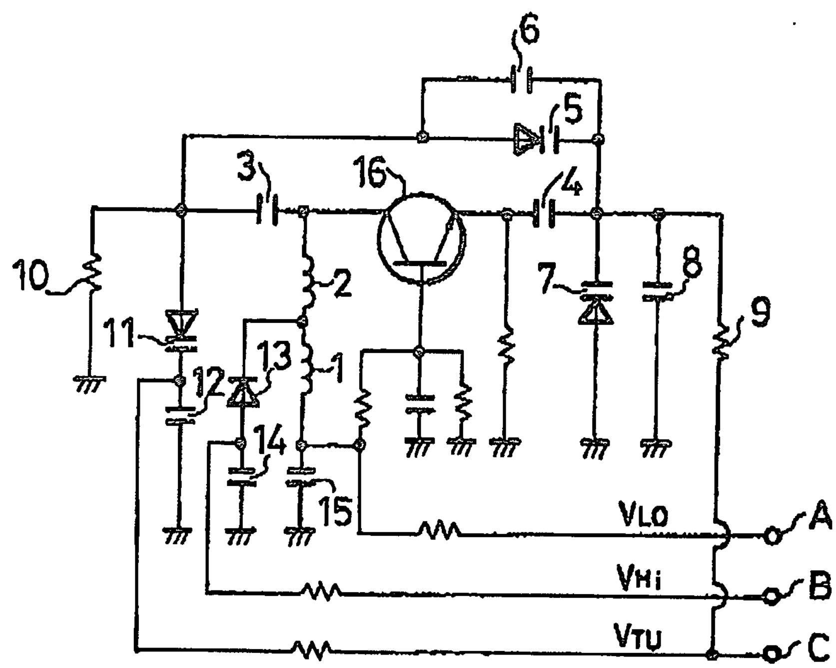


Fig.8

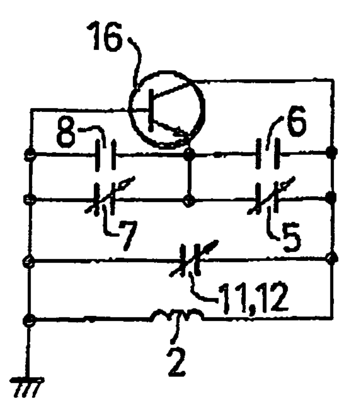


Fig.9

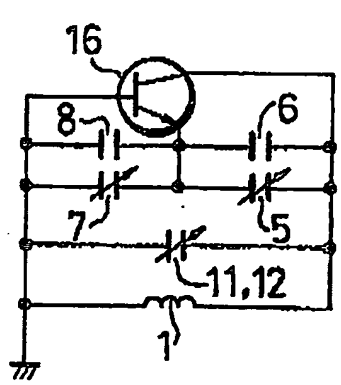


Fig.10

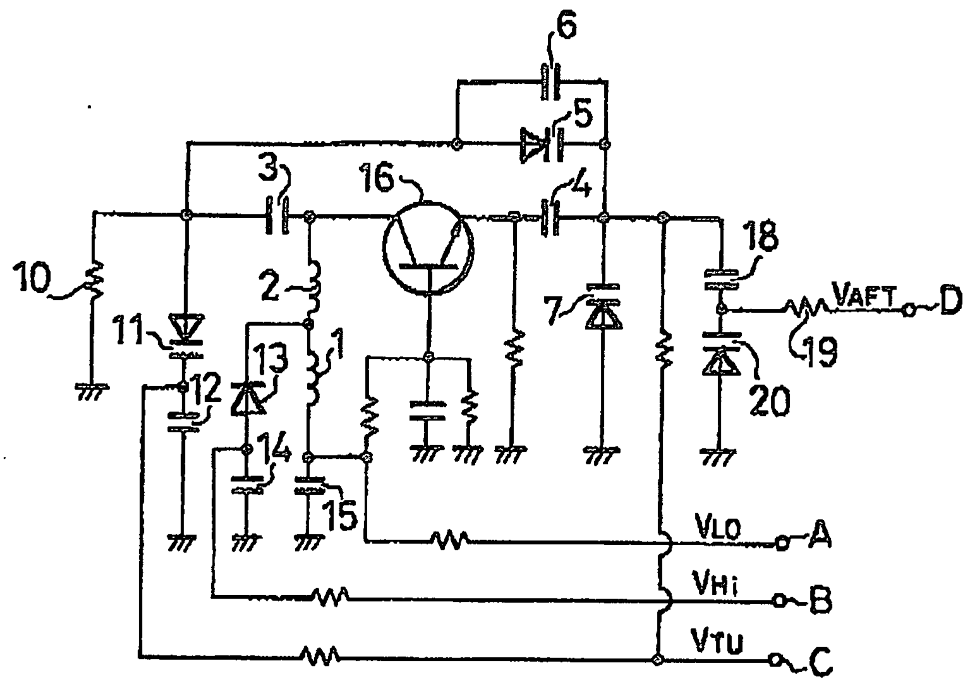


Fig.11

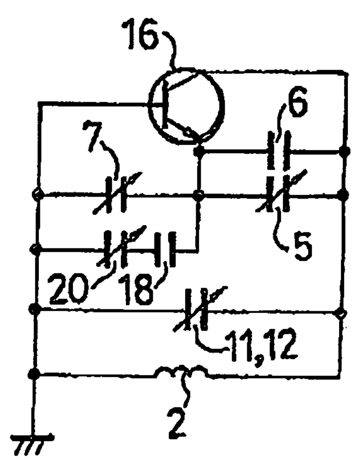
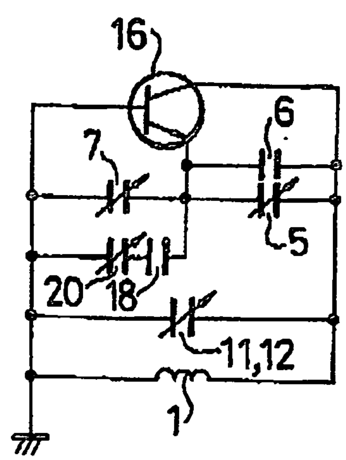


Fig.12



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LOCAL OSCILLATION CIRCUIT

This invention relates to a local oscillation circuit. In particular, it relates to a circuit which is suitable for use in a tuner that receives signals over a plurality of frequency bands.

In a superheterodyne type receiver, a received signal is converted to an intermediate frequency signal, of a predetermined frequency, by mixing the received signal with a local oscillation signal generated with a local oscillation circuit inside the receiver. To convert a received signal, for example, for two different frequency bands (low and high bands) to a predetermined frequency, the local oscillation frequency of the local oscillation circuit must be switched for each band.

An object of the present invention is to provide a local oscillation circuit by means of which the variable frequency range at high-band reception can be made wider than in conventional circuits and oscillation during the reception of each band can be stabilized, and the variable AFT (automatic fine tuning) range at the reception of each band can be made uniform without requiring an increase in the number of parts.

According to the present invention, there is provided a local oscillation circuit, in which a first and a second frequency-band resonance coil are connected sequentially in series between the collector and the base of an oscillation transistor. This local oscillation circuit switches the oscillation frequency of a cicuit by switching the second frequency-band resonance coil between a short-circuited status and a non-short-circuited status, wherein a feedback capacitor is connected between the

point at which the first and the second frequency-band resonance coils are connected, and the emitter of the oscillation transistor.

When the second frequency band resonance coil is switched between a short-circuited status and a non-short-circuited status, the connection position at which the feedback capacitor connected between a point at which the first frequency band resonance coil and the second frequency band resonance coil are connected and the emitter of the oscillation transistor is switched equivalently. Thus, the relative size of the capacity value of the feedback circuit at the reception of each band is optimized.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a circuit diagram showing the construction of a first embodiment of the present invention;

Figure 2 is an equivalent circuit diagram at high-band reception of the first embodiment;

Figure 3 is an equivalent circuit diagram at low-band reception of the first embodiment;

Figure 4 is a circuit diagram showing the construction of a second embodiment of the present invention;

Figure 5 is an equivalent circuit diagram showing the construction of the circuit at high-band reception of the second embodiment;

Figure 6 is an equivalent circuit diagram at low-band reception of the second embodiment;

Figure 7 is a circuit diagram showing the construction of a first embodiment of the prior art;

Figure 8 is an equivalent circuit diagram at high-band reception of the first embodiment of the

prior art;

Figure 9 is an equivalent circuit diagram at low-band reception of the first embodiment of the prior art;

Figure 10 is a circuit diagram showing the construction of a second embodiment of the prior art;

Figure 11 is an equivalent circuit diagram at high-band reception of the second embodiment of the prior art; and

Figure 12 is an equivalent circuit diagram at low-band reception of the second embodiment of the prior art.

A description will now be given of a first conventional circuit with reference to the circuit diagram shown in Figure 7. In Figure 7, a tuning circuit, formed by a low-band tuning coil 1, a high-band tuning coil 2, a tuning variable capacity diode 11, and a tuning compensation capacitor 12, is connected to the collector of an oscillation transistor 16. Variable capacity diodes 5 and 7 as feedback elements are connected between the collector-emitter and between the emitter-ground of the transistor 16. Capacitors 6 and 8 employed as compensation are connected in parallel to the variable capacity diodes 5 and 7. The cathode of a switching diode 13 is connected to a point at which the low-band tuning coil 1 and the high-band tuning coil 2 are connected in order to switch between a high and a low band. The anode of the switching diode 13 is grounded via a capacitor 14 and connected to the high-band terminal B via a power feed resistor. A selection voltage V_{Hi} is supplied to this high-band terminal B. The capacitors 3 and 4 are used to block DC currents, and the capacitor 15

is for the grounding of the low-band tuning coil 1. The point at which this capacitor 15 and the low-band tuning coil 1 are connected is connected to the low-band terminal A via the power feed resistor. A selection voltage V_{LO} is supplied to this low-band terminal A. A resistor 9 is used to supply a tuning voltage, one end of which is connected to a tuning voltage terminal C to which a tuning voltage V_{TU} is supplied. A resistor 10 is used to apply a DC bias for variable capacity diodes 5 and 11.

With the above-mentioned construction, at high-band reception, a selection voltage V_{Hi} is supplied to the high-band terminal B, the switching diode 13 is turned on, and a resonance circuit is formed by the high-band tuning coil 2, and the combined capacitor 12 and the variable capacity diode 11. The Colpitts oscillation circuit shown in Figure 8 is formed by the feedback circuit of the variable capacity diodes 5 and 7 and capacitors 6 and 8, and a transistor 16. At low-band reception, a selection voltage V_{LO} is supplied to the low-band terminal A, and the switching diode 13 is turned off. As a result, a resonance circuit shown in Figure 9 is formed by the low-band tuning coil 1.

At the reception of both bands, the capacity of the variable capacity diode 11 varies in response to a selection voltage V_{TU} which is supplied to the tuning voltage terminal C, thus an oscillation frequency varies.

Next, a second conventional circuit will be explained with reference to a circuit diagram shown in Figure 10.

In Figure 10, one end of the capacitor 18 is connected to the cathode side of the variable capacity diode 7 for feedback. To the other end of

the capcitor 18, a power feed resistor 19 for an AFT (automatic fine tuning) and the cathode of the variable capacity diode 20 for the AFT are connected. The other end of the power feed resistor 19 is connected to an AFT terminal D, and the anode of the variable capacity diode 20 is grounded.

With the above-mentioned construction, at high-band reception, a selection voltage V_{Hi} is supplied to the high-band terminal B, and the switching diode 13 is turned on, the circuit arrangement of which is shown in Figure 11. At low-band reception, a selection voltage V_{LO} is supplied to the low-band terminal A, and the switching diode 13 is turned off, the circuit arrangement of which is shown in Figure 12. At the reception of both bands, the capacity of the variable capacity diode 11 is made to vary in response to the selection voltage V_{TU} which is supplied to the tuning voltage terminal C, causing an oscillation frequency to vary. To prevent variations in oscillation frequencies caused by temperature or power-source voltage variations, an AFT voltage V_{AFT} is supplied to the AFT terminal D to cause the capacity of the variable capacity diode 20 to vary. A capacity combined with that of the capacitor 18 is made to act on the capacity of the variable capacity diode 7 so that the oscillation frequency is stabilized.

In the Colpitts local oscillation circuit shown in Figures 7 and 10, since the capacity value of each section of the circuit is the same as for both a high and a low band, the range in which the oscillation frequency is variable cannot be set at will for each band. The capacity value of each section of a feedback circuit must be suitably set in accordance with the oscillation frequency in order to

keep the oscillation state stable. The relation between those capacity values should preferably be set as follows: at high-band reception, the capacity between the collector and the emitter is made smaller and the capacity between the emitter and the base is made larger; conversely, at low-band reception, the capacity between the collector and the emitter is made larger and the capacity between the emitter and the base is made smaller. With the construction of the local oscillation circuit, however, the relation of the capacity values mentioned above cannot be realized. In the above local oscillation circuit shown in Figure 10, the AFT capacity (the combined capacity by the variable capacity diode 20 for the AFT and the capacitor 18) is the same as at high-band and low-band reception, and the variable AFT range (the variable frequency range by the AFT voltage V_{AFT}) is proportional to the local oscillation frequency. Consequently, the variable AFT range differs for both bands. That is, a problem arises in that the variable AFT range is larger at high-band reception and smaller at low-band reception.

Embodiments of the present invention are described below with reference to Figures 1 to 6.

Figure 1 is a circuit diagram showing the construction of a first embodiment of the present invention. In this figure, parts identical to those used in the example of the prior art shown in Figure 7 are given the same numerals, and an explanation thereof is omitted. This embodiment is characterised in that a feedback capacitor 21 is disposed between the point at which the low-band tuning coil 1 and the high-band tuning coil 2 are connected and the cathode side of the variable capacity diodes 5 and 7 for feedback in place of the capacitors 6 and 8 shown in

Figure 7.

With this construction, at high-band reception, since a selection voltage V_{Hi} is supplied to the high-band terminal B, which turns on the switching diode 13, the feedback capacitor 21 is grounded. Therefore, the feedback capacitor 21 is equivalently connected in parallel to the variable capacity diode 7, as shown in Figure 2, thus increasing the capacity between the emitter and the base.

At low-band reception, since a selection voltage V_{LO} is supplied to the high-band terminal A, which turns off the switching diode 13, the feedback capacitor 21 is connected to the collector of the transistor 16 via the high-band tuning coil 2. Therefore, the feedback capacitor 21 is equivalently connected in parallel to the variable capacity diode 5, as shown in Figure 3, thus increasing the capacity between the collector and the emitter.

As described above, in this embodiment, at high-band reception, the capacity between the collector and the emitter is decreased, and the capacity between the emitter and the base is increased. At low-band reception, the capacity between the collector and the emitter is increased, and the capacity between the emitter and the base is decreased. As a result, at high-band reception, since a fixed capacitance is not connected between the collector and the emitter, the variable frequency range can be made wider and, in addition, the oscillation at low-band reception can be stabilized.

A second embodiment of the present invention is shown in Figure 4. In this figure, parts identical to those used in the example of the prior art shown in Figure 10 are given the same

numerals, and an explanation thereof is omitted.

This embodiment is characterized in that a feedback capacitor 22 is disposed between the point at which the low-band tuning coil 1 and the high-band tuning coil 2 are connected and the point at which the capacitor 18 and the cathode side of the variable capacity diode 20 for the AFT are connected in place of the capacitor 6 shown in Figure 10.

With the above-mentioned construction, at high-band reception, since a selection voltage V_{Hi} is supplied to the high-band terminal B, which turns on the switching diode 13, one end of the feedback capacitor 22 is grounded via the capacitor 14. Therefore, the feedback capacitor 22 is configured to be equivalently connected in parallel to the variable capacity diode 20, as shown in Figure 5.

At low-band reception, since a selection voltage V_{LO} is supplied to the low-band terminal A, which turns on the swtiching diode 13, one end of the feedback capacitor 22 is connected to the collector side of the transistor 16 via the high-band tuning coil 2. Therefore, the feedback capacitor 22 is configured to be equivalently connected in parallel to the capacitor 18 for the AFT and the variable capacity diode 5, as shown in Figure 6.

As described above, in the embodiment, at high-band reception, since the feedback capacitor 22 is added in parallel to the variable capacity diode 20 for the AFT, the variable AFT range decreases. At low-band reception, since the feedback capacitor 22 is added as the series capacitance of the variable capacity diode for the AFT, the variable AFT range increases. Consequently, the variable AFT range is made uniform for both bands. Because of the feedback capacitor 22, at high-band reception the value of the

capacity between the emitter and the base is larger, and at low-band reception, that capacity between the collector and the emitter is larger. As a result, an oscillation at the reception of each band is stabilized, and the range in which the oscillation frequency is variable can be adjusted for each band to relatively arbitrary settings.

As has been explained above, according to the present invention, the variable frequency range at high-band reception can be made wider without requiring an increase in the number of parts. An advantage can be obtained in that oscillation is stabilized and the variable AFT range is made uniform at each band.

Many widely different embodiments of the present invention can be made without departing from the spirit and scope, therefore, it is to be understood that this invention is not limited to the specific embodiments thereof except as defined in the appended claims.

CLAIMS

1. A local oscillation circuit, including a first and a second frequency-band resonance coil connected sequentially in series between the collector and the base of an oscillation transistor that switches the oscillation frequency of a circuit by switching said second frequency-band resonance coil between a short-circuited status and a non-short-circuited status, and a feedback capacitor connected between the junction of said first and said second frequency-band resonance coils, and the emitter of said oscillation transistor.

2. A local oscillation circuit as claimed in Claim 1, wherein the feedback capacitor is connected between the junction of said first and second frequency-band resonance coils, and a junction between a first variable capacity diode connected between the collector and emitter of the transistor, and a second variable capacity diode connected between the emitter and ground.

3. A local oscillation circuit as claimed in Claim 1 including an automatic fine tuning (AFT) means and wherein the feedback capacitor is connected, at its emitter side, to said AFT means.

4. A local oscillation circuit substantially as hereinbefore described with reference to, and as illustrated by, Figures 1 to 3, or Figures 4 to 6, of the accompanying drawings.